

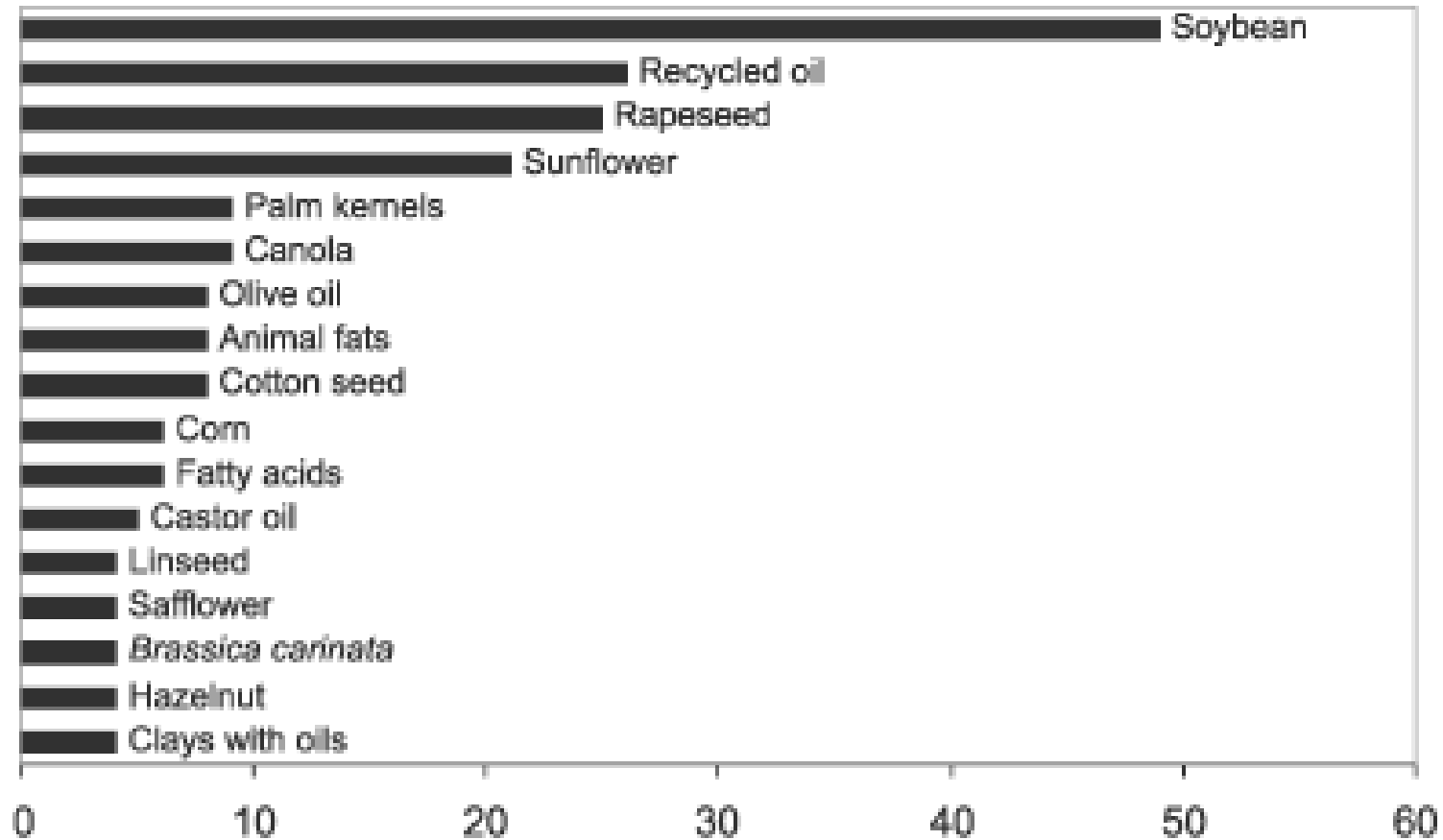
## Algae:OMEGA

O ffshore  
M embrane  
E nclosures for  
G rowing  
A lgae



# Source for Biodiesel Production

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Soy vs algae for annual jet fuel needs in US

# ***Botryococcus braunii***

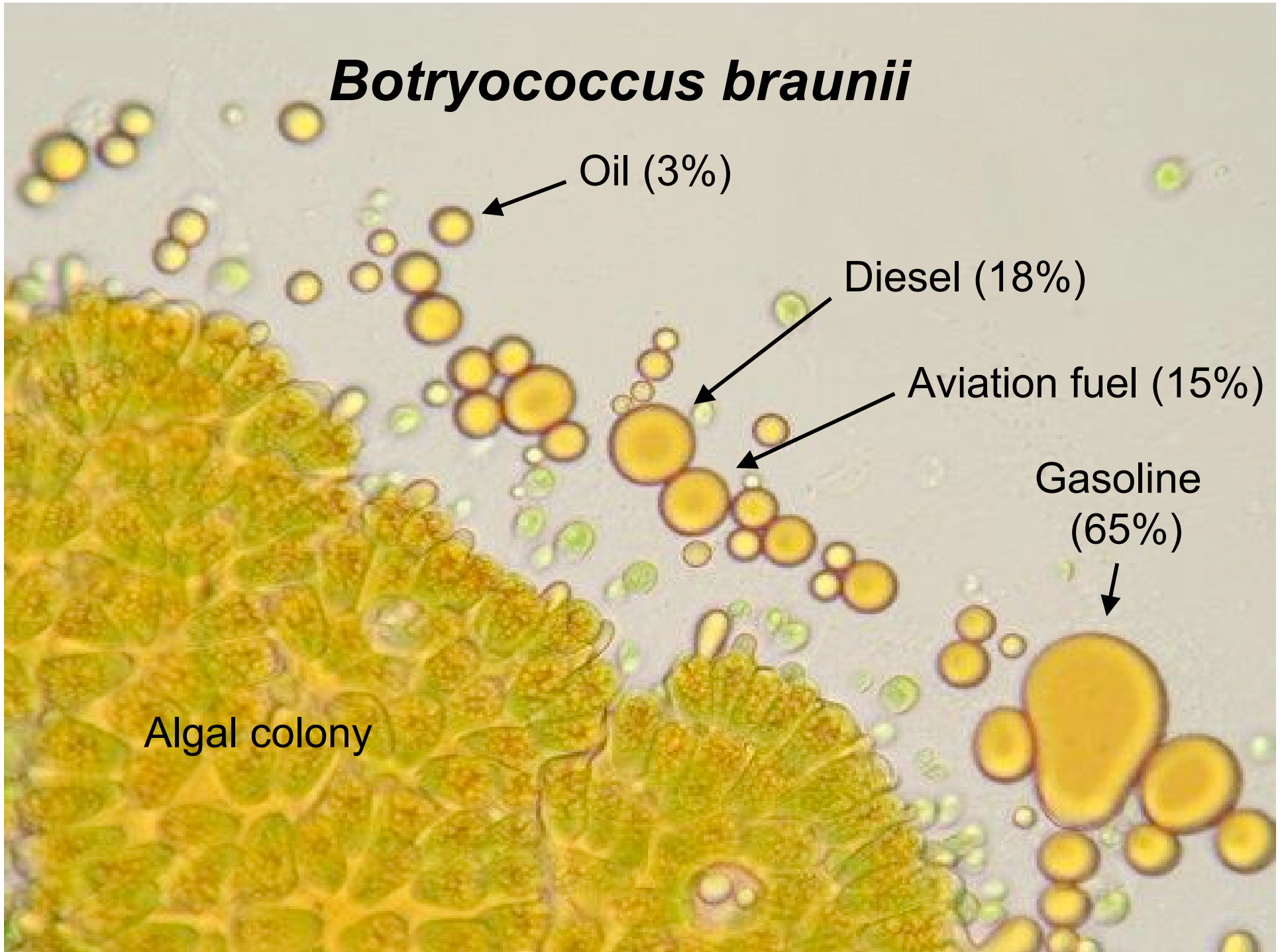
Oil (3%)

Diesel (18%)

Aviation fuel (15%)

Gasoline  
(65%)

Algal colony





# Current Cultivation Systems

**1: Open circulating ponds (raceways)**



**2: Closed bioreactors**



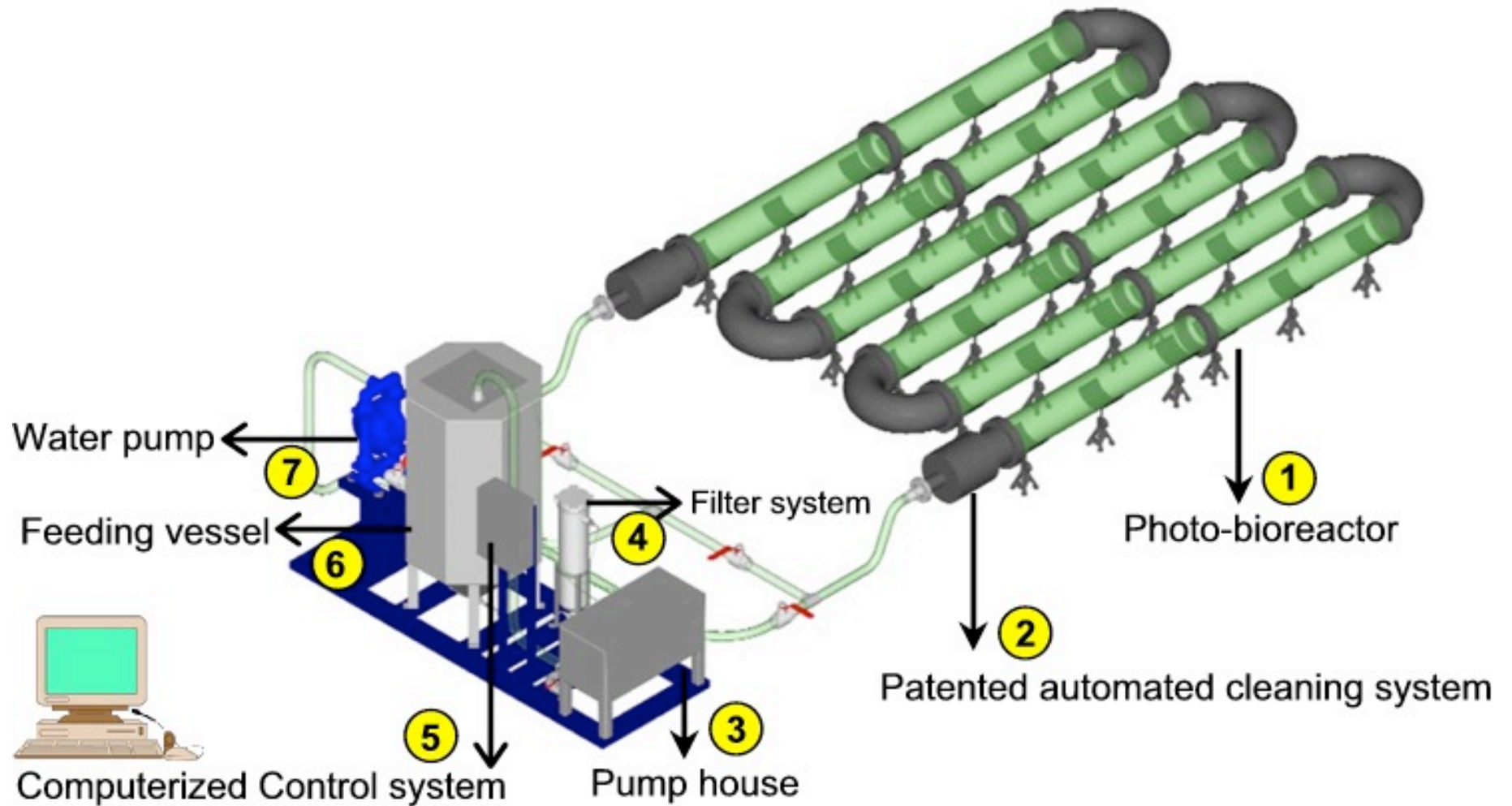


## How will the system scale?

Conception of microalgae biodiesel production Aquatic Species Program, U.S. DOE NREL 1987. Note raceway growth and settling-harvesting ponds



# Algal Bioreactor





# Algal Bioreactor

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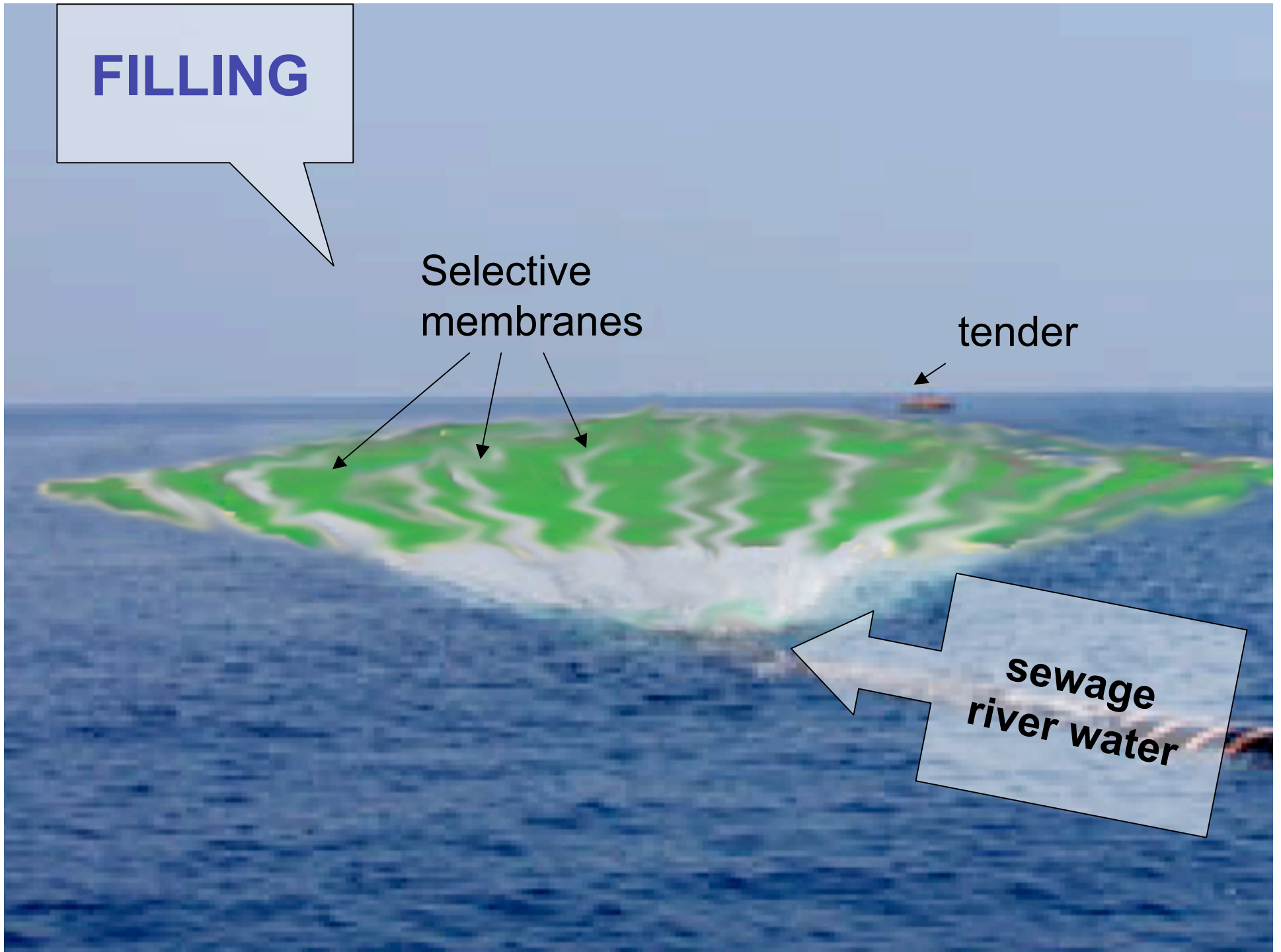
[http://biokinginc.trustpass.alibaba.com/product/11894447/Algae\\_Photo\\_Bioreactor.html](http://biokinginc.trustpass.alibaba.com/product/11894447/Algae_Photo_Bioreactor.html)

**FILLING**

Selective  
membranes

tender

sewage  
river water





**GROWING**

**Solar Energy**

$O_2$

**Gas exchange**

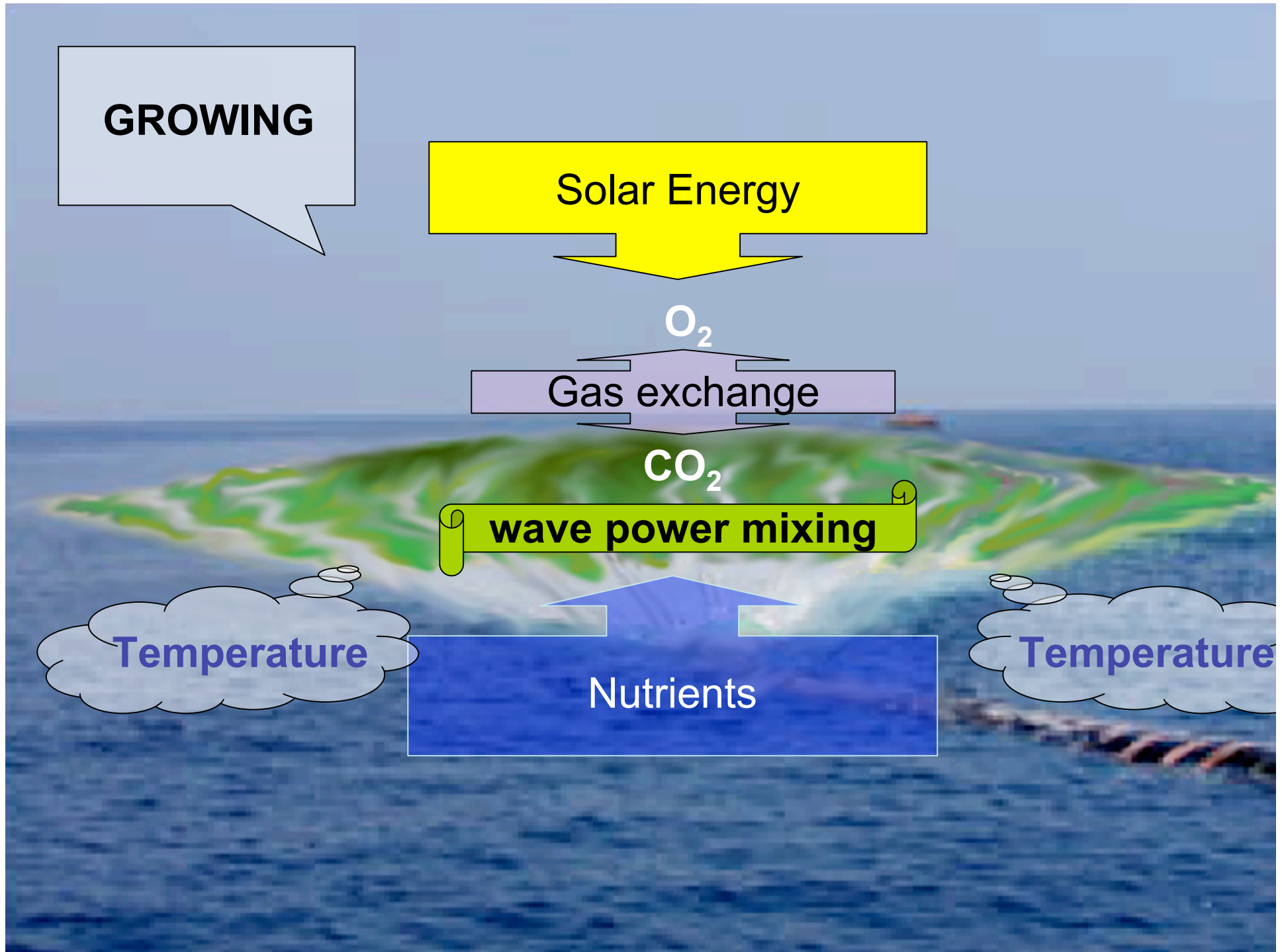
$CO_2$

**wave power mixing**

**Temperature**

**Nutrients**

**Temperature**



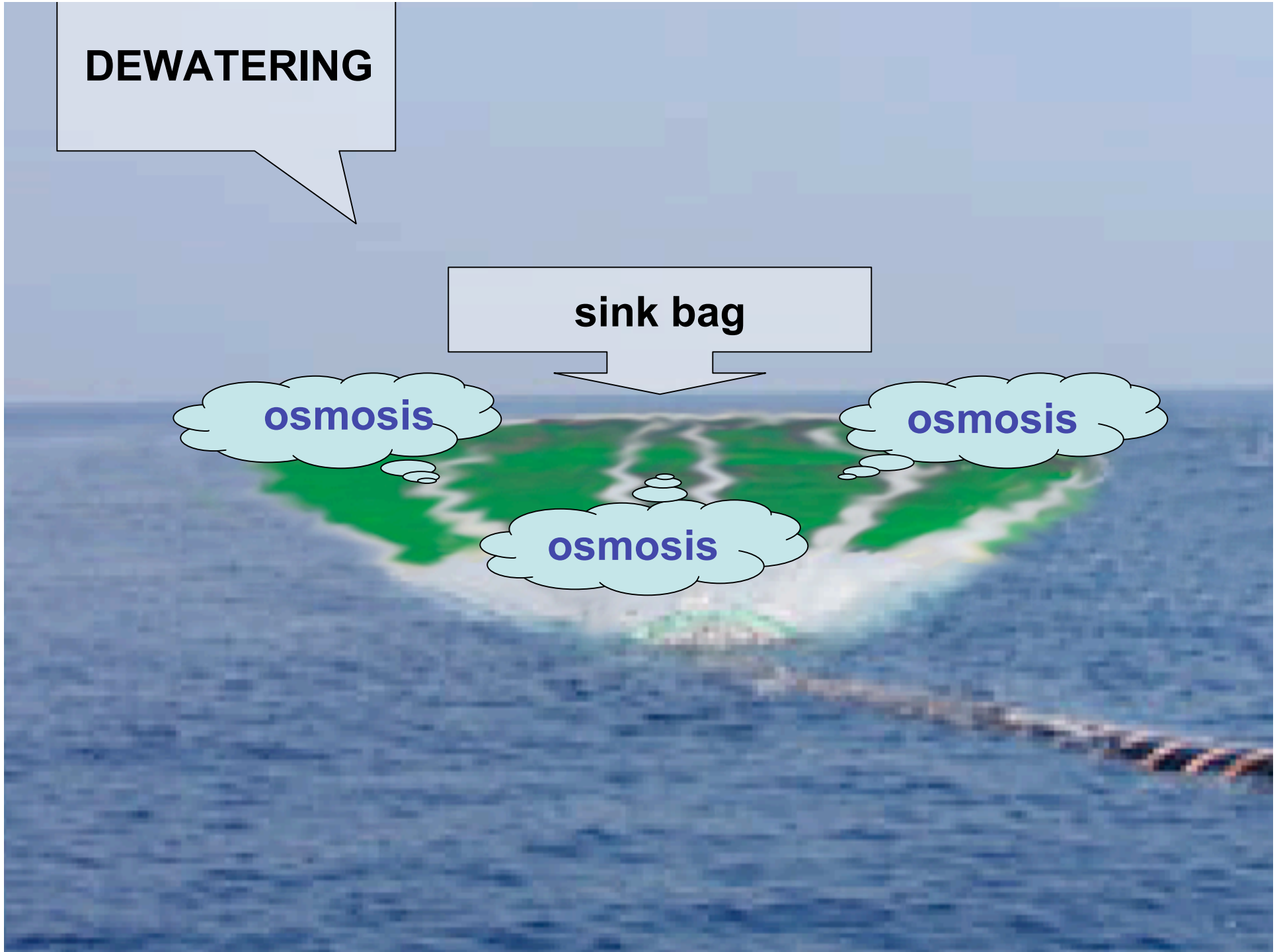
**DEWATERING**

**sink bag**

**osmosis**

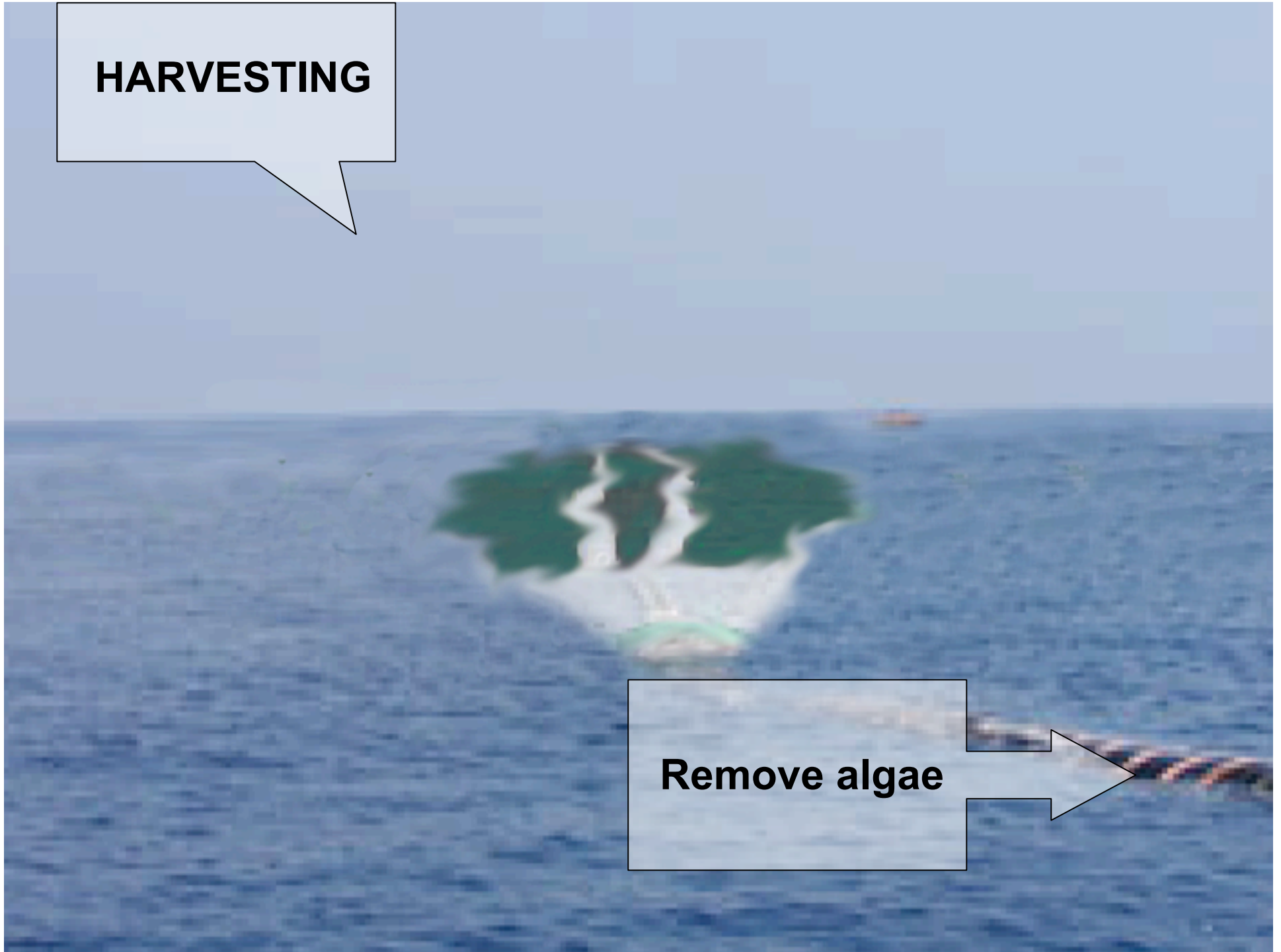
**osmosis**

**osmosis**



**HARVESTING**

**Remove algae**



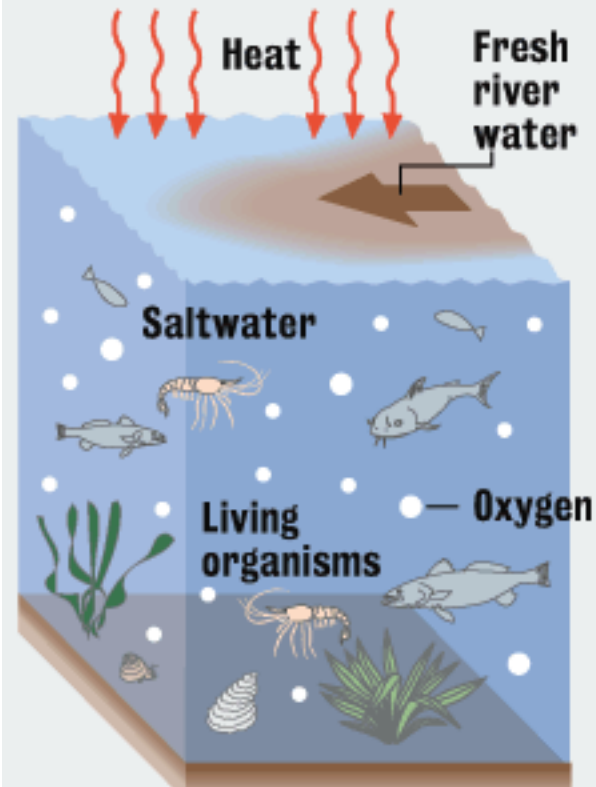




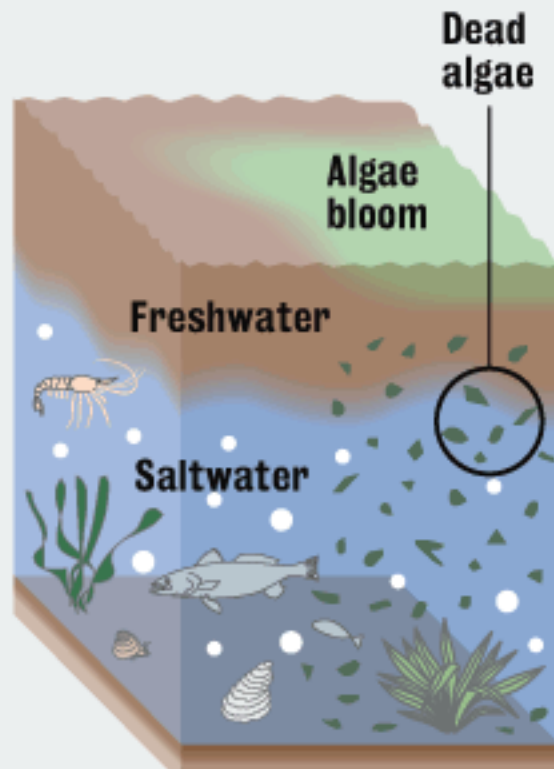




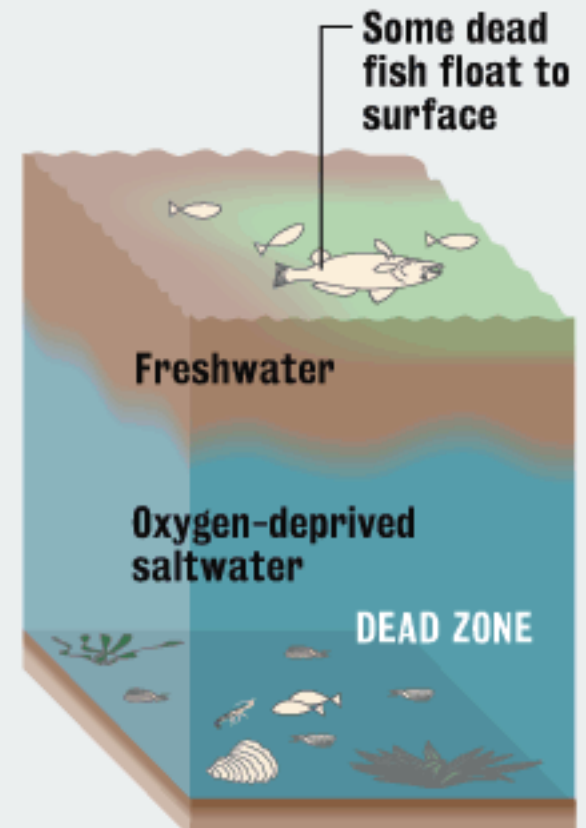
# HOW THE DEAD ZONE FORMS



**Fertilizer runoff**

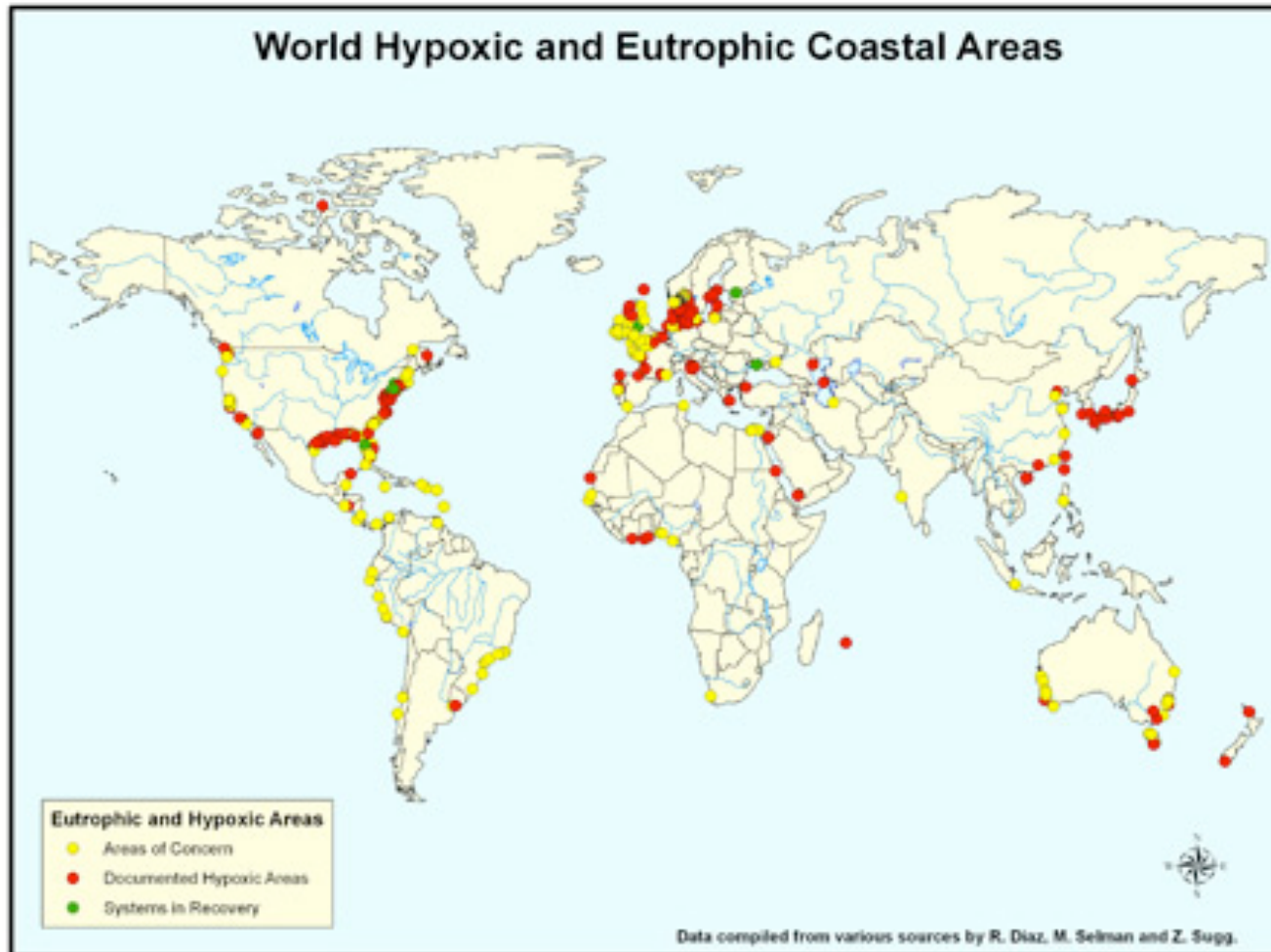


**Stratified  
water column**



**Suffocation**

# Dead Zones 2008



Science vol. 321: 15 Aug 2008

OMEGA for using and recycling sewage...

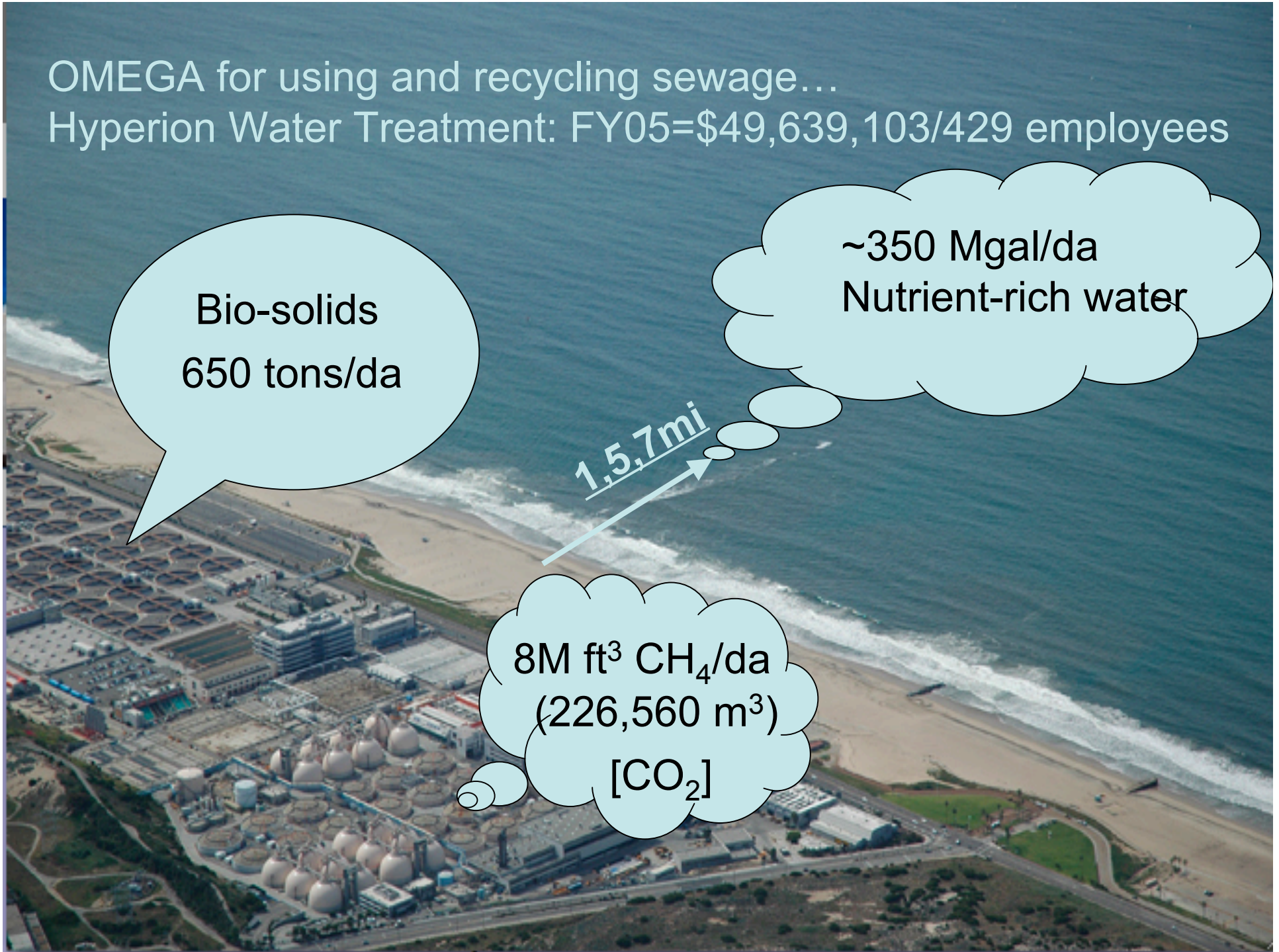
Hyperion Water Treatment: FY05=\$49,639,103/429 employees

Bio-solids  
650 tons/da

~350 Mgal/da  
Nutrient-rich water

1.5, 7mi

8M ft<sup>3</sup> CH<sub>4</sub>/da  
(226,560 m<sup>3</sup>)  
[CO<sub>2</sub>]





**Critical factors**

raceway



bioreactor



Algae:OMEGA



Capital/op cost	Low/medium	High/medium	Low/medium
Temp. control	Minor problem	Severe problem	Minor problem
Evaporation	Severe problem	Minor problem	Minor problem
Mixing	Low energy	High energy	low energy
Invasive spp.	Severe problem	Minor problem	Minor problem
Environmental impact	Unclear	Unclear	<b>Good</b>

**GROWING**

**Solar Energy**

$O_2$

**Gas exchange**

$CO_2$

**wave power mixing**

**Temperature**

**Nutrients**

**Temperature**

